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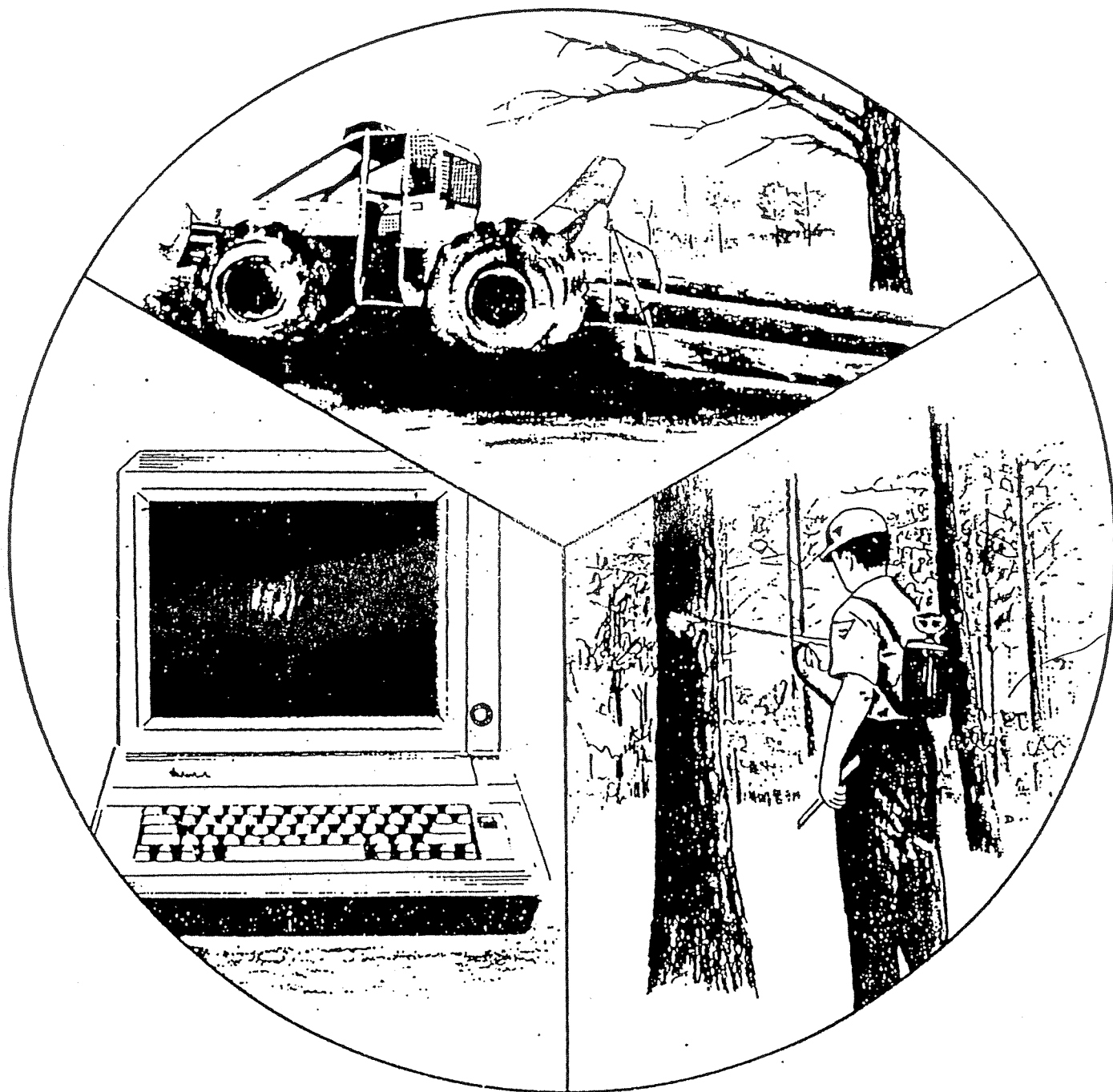


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# User's Manual for Total-Tree Multiproduct Cruise Program

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# User's Manual for Total-Tree Multiproduct

## Cruise Program

### ABSTRACT

The Total-Tree Multiproduct Cruise Program is a user-friendly, interactive computer program that uses standard tree-cruise data to estimate the weight and volume of the total tree, saw logs, plylogs, chipping logs, pulpwood, crown firewood, and logging residue in timber stands. Input is cumulative cruise data for tree counts by d.b.h. alone or by d.b.h. class and total height, height to 4-inch top, or saw-log merchantable height for individual species or species groups. Output is in tables: (1) board-foot volume by d.b.h., (2) total-tree and tree-component biomass by d.b.h. class, (3) a summary table, and (4) projected annual growth by stand component and species. Output can be expressed in tons, cords, cunits, or board feet per acre, or by cutting units and tract totals. The program is written in FORTRAN V for a mainframe and in PASCAL for the IBM-PC microcomputer. This manual describes the program and how to enter cruise data to obtain desired output for both the mainframe and microcomputer versions.

Keywords: Computer program, inventory, biomass, tree weight, tree volume.

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## Introduction

Timber utilization practices are rapidly changing. The southern pines are now tree-length logged and marketed for veneer, saw logs, and pulpwood by weight rather than measured by scale stick to determine board feet or cords. Poor-quality hardwoods are now harvested for total-tree fuel chips, and logging residue from sawtimber hardwoods is marketed for firewood. To stay abreast of the changing utilization practices, to save time, and to reduce cruise computation errors, foresters need a versatile, easy-to-use procedure for automatically estimating the weight and volume of the total tree and its components (saw logs, plylogs, chipping logs, pulpwood, firewood). The Total-Tree Multiproduct (TTMP) Cruise Program meets this need.

TTMP-Cruise Program is a computer program designed for general forestry application. It accepts cumulative cruise data collected by standard timber cruise procedures. It provides per acre or per area estimates of total-tree and tree-component biomass and product yields for trees 1-inch d.b.h. and larger. Area estimates can be summarized by cutting units within a tract. The output estimates can be expressed in tons, cords, or cunits, and in board feet by using the Doyle, Scribner, or International 1/4-inch board-foot rules for saw-log volumes.

This manual is a guide to the user of the TTMP Cruise Program and will assist in the interpretation of biomass and product estimates it provides. The manual also explains the program's capabilities, how it is designed, and how it calculates forest biomass and product estimates.

The mainframe version is written in Fortran V and is designed to be accessed from remote terminals. The use of standard language syntax simplifies the conversion of this program for running on other systems supporting FORTRAN V. It is currently operational on a CDC CYBER 750 and an IBM 370. The microcomputer version is written in UCSD PASCAL for operation on IBM-PC and IBM compatible microcomputers that use the p-System (C2.A) operating systems developed by Network Consulting, Inc. (NCI).<sup>1</sup> It is a turnkey program and requires two disk drives

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<sup>1</sup> Copyright C 1984, Network Consulting, Inc.; Copyright C 1984, Softech Microsystems, Inc.

and a minimum of 256K RAM storage. The program was developed by the Utilization of Southern Timber Research Work Unit, USDA Forest Service, Southeastern Forest Experiment Station, in cooperation with the Georgia Forestry Commission and the University of Georgia's School of Forest Resources. For information on obtaining either version, write to the Southeastern Forest Experiment Station, 200 Weaver Boulevard, Asheville, NC 28804.

The program is designed for use by foresters or clerical personnel with little or no previous computer experience. The program prompts the user to enter information describing the cruise and the necessary tree counts. Data entry in the microcomputer version is interactive, fast, menu-driven, and self-explanatory. Special features are included that minimize the number of user key strokes per run. Data can be quickly entered and edited. The interactive procedure of the mainframe is self-explanatory and easily correctable. The same input data is required for both versions and the output is identical.

The first version of the TTMP Cruise Program, called Total Biomass Cruise Program (Clark and Field 1981), has been operational for 3 years. The program has been used by the Georgia Forestry Commission to analyze more than 300 cruises. Other States, industries, consultants, and the USDA Forest Service have used it experimentally and support its increased availability.

### Program Design

The TTMP Cruise Program uses tree data commonly measured in standard cruise procedures to estimate not only conventional forest products but total-tree and residual biomass.

### Tree Size Classes

Trees must be separated into three size classes for input, analysis, and output:

Saplings--trees 1.0 to 4.9 inches d.b.h.

Pulpwood--or roundwood trees  $\geq$  5.0 inches d.b.h.

Sawtimber--trees  $\geq$  9.0 inches d.b.h. for pine and trees  $\geq$  11.0 inches d.b.h. for hardwoods containing a minimum of one 16-foot number 3 saw log

The mainframe version requires that pulpwood trees be entered in two tree size classes:

Pulpwood--or roundwood trees 5.0 to 8.9 inches d.b.h. for pine and 5.0 to 10.9 inches d.b.h. for hardwoods

Large pulpwood--or roundwood trees  $\geq$  9.0 inches for pine and trees  $\geq$  11.0 inches for hardwoods

## Tree Dimensions Measured

During a cruise, the user can choose among various combinations of tree d.b.h. and height for measurements. Trees can also be tallied by d.b.h. alone, but this will produce less-precise summaries. The following combinations of tree dimensions and their range by tree size class can be accepted by the program. D.b.h. can be tallied at intervals of 1 or 2 inches up to 30 inches:

### Tree dimension combinations

### Size class and tally interval

#### SAPLINGS

d.b.h.	1.0 to 4.0 inches
d.b.h. and tree total height	10 to 90 ft in height at 5- or 10-ft intervals

#### PULPWOOD AND LARGE PULPWOOD

d.b.h.	$\geq$ 5.0 inches
d.b.h. and tree total height	10 to 140 ft in height at 10-ft intervals or 20 to 100 ft in height at 5-ft intervals
d.b.h. and height to a 4-in d.o.b. top	10 to 140 ft in height at 10-ft intervals or 5 to 85 ft in height at 5-ft intervals

#### SAWTIMBER

d.b.h.	$\geq$ 9.0 inches for pine $\geq$ 11.0 inches for hardwoods
d.b.h. and tree total height	10 to 140 ft in height at 10-ft intervals or 30 to 110 ft in height at 5-ft intervals
d.b.h. and height to a 4-in d.o.b. top	10 to 140 ft in height at 10-ft intervals or 20 to 100 ft in height at 5-ft intervals
d.b.h. and saw-log merchantable height	1.0 to 6.0 (16.3 ft) logs in height at half-log intervals

The selected d.b.h. and heights measured should be based on the type of timber cruised and objective of the cruise. When cruising pines, d.b.h. in combination with total height or height to a 4-inch d.o.b. top will give good estimates of the total tree, stem to pulp top, and stem to a fixed saw-log top of 7 inches. D.b.h. and saw-log merchantable height will give good estimates of the stem to a saw-log variable top. When cruising hardwoods by hard hardwood and soft hardwood groups, d.b.h. and total heights or height to a 4-inch top will also give good estimates of the total tree, stem to 4-inch top. These measurement combinations, however, can result in less-accurate estimates of the merchantable saw-log stem since these measurement combinations estimate to a fixed top of 9 inches d.o.b. and not a variable saw-log top. To obtain the best estimate of the saw-log merchantable stem, hardwoods should be tallied by d.b.h. and saw-log merchantable height.

### Types of Cruises

The program has the capability of analyzing cruise data collected according to the following specifications:

1. Fixed-area plot--for any specified circular plot size,
2. Point sample--by using a prism with any specified prism factor,
3. Strip cruise--given width and total length of strip or percent of tract cruised and tract acreage,
4. 100 percent tree tally.

All trees > 1.0 inch d.b.h. can be tallied by the same cruise procedure, or saplings (1.0 to 4.9 inches d.b.h.) can be tallied by using a different cruise procedure than that used for trees  $\geq$  5.0 inches d.b.h.

### Species Tallied

The program contains weight and volume equations for the 10 most important species or species groups for each of the three main physiographic regions of the South--Gulf and Atlantic Coastal Plains, Piedmont, and Southern Appalachian Mountains. Thus the user can select weight and volume prediction equations developed for a general geographic area to expand specific-area cruise data to forest stand biomass estimates. Equations are stored in the program for the following species or species group. Also shown are the location, number, and d.b.h. range of the trees sampled to develop the species weight and volume equations used in the program.

<u>Species name</u>	<u>Species sampled</u>	<u>Locations sampled</u>	<u>Trees sampled</u>	<u>D.b.h. range</u>
			(No.)	(Inch)
COASTAL PLAIN REGION				
PINE	Natural loblolly, slash, longleaf combined	Alabama, Georgia, South Carolina	1285	1-24
HARD-HARDWOODS	Hard hardwood species-- white oak, water oak, laurel oak, hickory spp. combined	Coastal Plain of South and Southeast	303	1-20
SOFT-HARDWOODS	Soft hardwood species-- sweetgum, blackgum, red maple, water tupelo, green ash, yellow-poplar combined	Coastal Plain of South and Southeast	842	1-20
OAK SPECIES	White oak, water oak, laurel oak combined	Coastal Plain of South and Southeast	138	1-20
LIVE OAK	Live oak	Northwest Florida	28	5-20
SWEETGUM	Sweetgum	Coastal Plain of South and Southeast	313	1-20
PINE2	Same as PINE--allows user to tally pine in two classes, sawtimber or poles	Alabama, Georgia, South Carolina	1285	1-24
SAND PINE	Sand pine	Northwest Florida	36	4-14
PLANTATION PINE	Plantation slash pine	Georgia	139	2-12
CYPRESS	Pond cypress	Central Florida	58	5-18

Species name	Species sampled	Locations sampled	Trees sampled (No.)	D.b.h rang (Inch)
PIEDMONT REGION				
PINE	Natural loblolly and shortleaf combined	Alabama, Georgia, South Carolina	1006	1-20
HARD-HARDWOOD	Hard hardwood species-- southern red, scarlet, white oaks, and hickory combined	Georgia, Tennessee, South and North Carolina	189	1-20
SOFT-HARDWOOD	Soft hardwood species-- yellow-poplar, red maple, sweetgum, green ash, sycamore combined	Georgia, South and North Carolina	126	1-20
WHITE OAK	White oak	Georgia, South and North Carolina	63	1 -20
RED OAK	Southern red oak, scarlet oak combined	Georgia, Tennessee, South and North Carolina	98	1-22
SWEETGUM	Sweetgum	Georgia, South and North Carolina	61	1-20
PINE2	Same as PINE--allows user to tally pine in two classes, sawtimber or poles	Alabama, Georgia, South Carolina	1006	1-20
VIRGINIA PINE	Virginia pine	Georgia	25	6-14
PLANTATION PINE	Plantation loblolly pine	Alabama, Georgia, South Carolina	434	2-12
YELLOW-POPLAR	Yellow-poplar	Georgia, South and North Carolina	65	1-20
SOUTHERN APPALACHIAN MOUNTAIN REIGON				
PINE	Natural loblolly and shortleaf combined	Alabama, Georgia, South Carolina	1006	1-20
HARD-HARDWOOD	Hard hardwood species-- Northern red, white, chestnut, black, and scarlet oaks, hickory, black locust, sweet birch combined	Georgia, North Carolina	269	1-24



<u>Species name</u>	<u>Species sampled</u>	<u>Locations sampled</u>	<u>Trees sampled</u> (No.)	<u>D.b.h. range</u> (Inch)
SOFT-HARDWOOD	Soft hardwood species-- yellow-poplar, red maple, basswood, blackgum combined	Georgia, North Carolina	113	1-24
WHITE OAK	White oak	North Carolina	28	5-22
RED OAK	Northern red oak	North Carolina	71	5-24
YELLOW-POPLAR	Yellow-poplar	North Carolina	65	5-28
WHITE PINE	White pine	Georgia	36	1-24
VIRGINIA PINE	Virginia pine	Georgia	25	1-14
RED MAPLE	Red maple	North Carolina	36	5-16
HICKORY	Hickory spp.	Georgia, North Carolina	54	5-22

A maximum of six species or species groups can be entered for each area or cutting unit and a total of nine different species groups can be summarized for a total tract. The PINE2 species group is included to allow foresters to tally pine timber in two classes--sawtimber for lumber and veneer, and pole-grade trees for utility poles and pilings or to tally cut-and-leave trees.

#### Component Weight and Volume Estimates

Total-tree and tree-component weight and volume equations for estimating the green weight of wood and bark in pounds, and volume of wood in cubic feet, are stored in the program by region, species, tree size class, dimension measured, and tree component. The equations used in the TTMP Cruise Program were developed from biomass data collected across the South by the Utilization of Southern Timber Research Work Unit (fig. 1) in cooperation with the forest industries, Region 8 of the USDA Forest Service, North Carolina State Hardwood Research Cooperative, Georgia Forestry Commission, and Tennessee Valley Authority. These equations are available upon request from the authors, Utilization of Southern Timber Research Work Unit, Forestry Sciences Laboratory, Carlton Street, Athens, GA 30602.

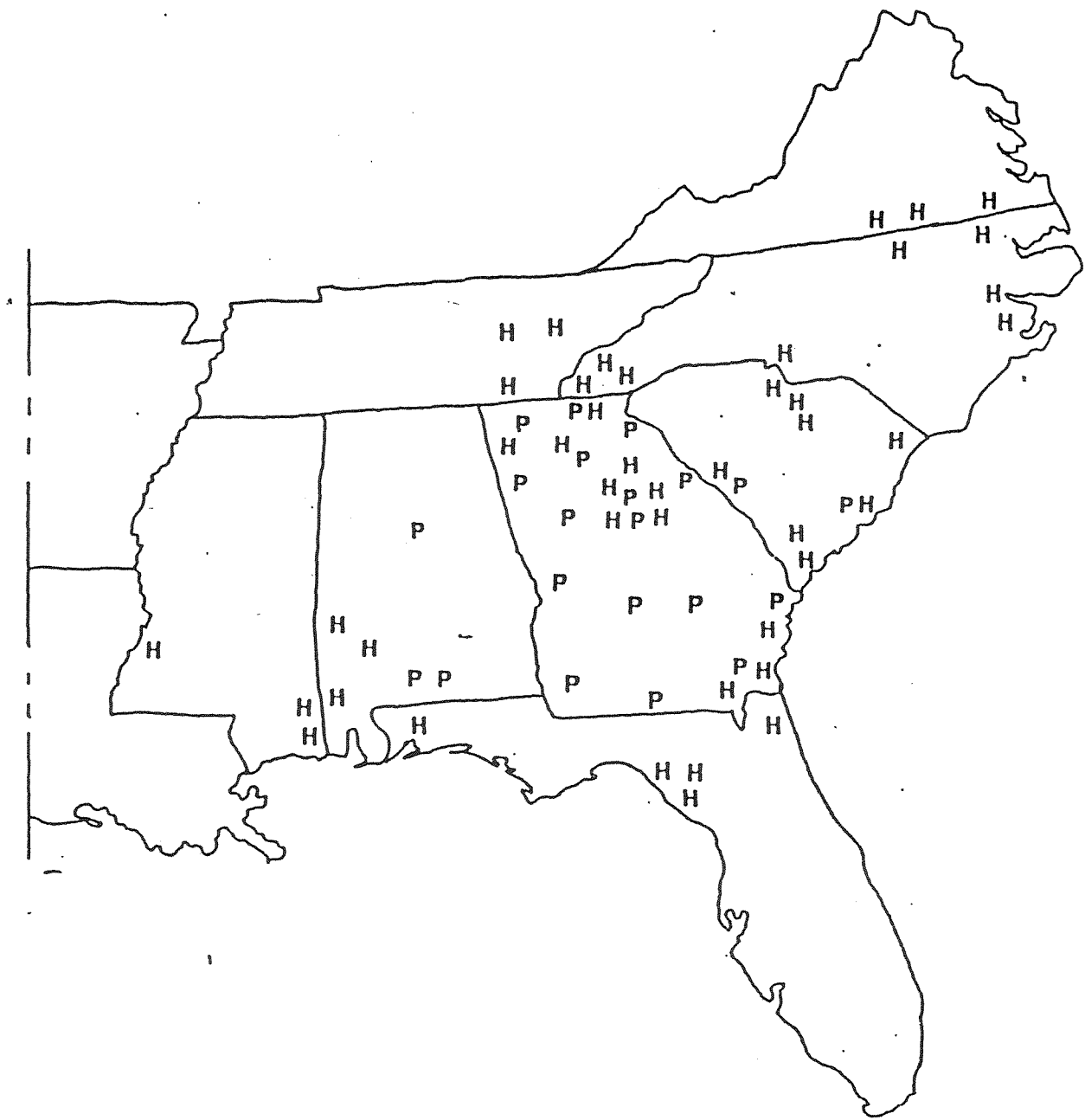


Figure 1.--Locations of stands where natural pine (P) and hardwood (H) trees were sampled for regional species equations.

The program prompts the user for the information needed to select the appropriate equations which are used with the tree-frequency counts to estimate total-tree and tree-component weights and volumes. Estimated weight in pounds and volume in cubic feet are converted to tons and cunits, respectively.

Total-tree and tree-component estimates in cords are calculated from the estimated weight of wood and bark to simulate one of the measurements used in selling wood. The following weight of wood and bark per cord equivalents are stored in the program:

<u>Geographic region and species group</u>	<u>Cord equivalent (Pounds)</u>
Coastal Plain	
Pine	5600
Hard hardwood	5700
Soft hardwood	5700
Piedmont	
Pine	5350
Hard hardwood	5700
Soft hardwood	5700
Appalachian Mountains	
Pine	5350
Hard hardwood	5800
Soft hardwood	5800

The pounds per cord equivalents are the same for hard hardwood and soft hardwood because soft and hard hardwoods are generally mixed when weighed at the woodyard. Users may enter their own factors for any of the species groups.

The user may specify the pulpwood d.o.b. top to be used for pine, hard hardwoods, and soft hardwoods in the analysis. This option allows the program to estimate more accurately the actual volumes to be harvested and what will be left as logging residue. The user may also request that the saw-log merchantable stem of natural southern pine be separated into small saw logs and into logs of suitable size for processing into veneer (plylogs). To do so, the user either specifies the minimum d.b.h. tree from which plylogs can be cut and the minimum top d.d.b. to which plylogs can be bucked or allows the program to use the default values of 13 inches d.b.h. and 10 inches d.o.b. top.

Upon request, the program will separate the stem of plantation pine into chipping logs and upper stem pulpwood. The user specifies a minimum d.o.b. top to which chipping logs can be cut and the minimum d.b.h. tree from which chipping logs can be processed or can use the default values of 8 inches d.b.h. and 6 inches d.o.b.

Board-foot volumes are estimated with equations developed from Mesavage and Girard (1956) volume tables (Appendix A). The user can specify the log rule (Doyle, Scribner, or International 1/4-inch) and form class to be used for estimating pine, hard hardwood, and soft hardwood board-foot volumes. No board-foot estimates are made unless d.b.h. and height (total height, height to 4-inch d.o.b. top, or saw-log merchantable height) are entered.

### Growth Projection

The estimated weight and volume of a stand and its components can be projected for up to 5 years into the future. The user can input growth measurements or use growth values stored in the program. The growth measurements

entered by the user consist of the previous 5 years' radial growth (excluding bark) and tree d.b.h. The user can enter the measurements for trees in both the pulpwood and the sawtimber-size classes for pine. The stored growth values consist of equations with d.b.h. used as the independent variable for predicting the radial growth of a tree. These equations were developed for pine, other softwoods, hard hardwood, and soft hardwoods by the three physiographic regions from forest inventory data collected in the Southeast by the Forest Inventory and Analysis Research Work Unit (FIA), Southeastern Forest Experiment Station, Asheville, NC (Joe P. McClure, Project Leader; pers. commun., 1983). Since default radial growth values used in the program are regional averages, users should enter radial growth measurements for the trees cruised to obtain more accurate growth projections.

Growth projections are made by using the stand table projection method (Avery 1967:233-235). This method assumes that trees in each diameter class are evenly distributed throughout the class and that each tree will grow at the average rate for that class. It also assumes that bark thickness does not change during the 5-year period. In addition to projecting growth in d.b.h., height projections are also made by using equations developed by FIA (Joe P. McClure, Pers. commun., 1983). Height growth equations are stored in the program for pine, other softwoods, hard hardwoods, and soft hardwoods for each of the three physiographic regions.

Mortality is then automatically subtracted from the projections by applying factors, based on FIA data, to the tree counts by d.b.h. class:

Tree d.b.h. class <hr/> (Inches)	Annual mortality rate(%) <hr/> (Softwoods)      (Hardwoods)	
< 6	1.9	1.1
> 6 - < 22	0.7	0.8
≥ 22	1.1	1.4

Projected tree and component weights and volumes are estimated by using the appropriate equations applied to the projected tree counts and d.b.h. and height values.

#### Data Input

Cruise data collected for a 40-acre pine-hardwood tract in the Coastal Plain will be used as an example in this manual. Trees 1.0 inch d.b.h. and larger were tallied in 2-inch classes with a 10-factor prism at 40 points in the tract. Default radial growth values were used to estimate growth. Exhibits 1 and 2 are examples of the completed field forms for recording cruise information and cumulative tree counts, by d.b.h. and height classes. Samples of blank forms are included at the end of the manual; however, conventional cruise tally cards can be used to record cruise data.

Exhibit 1. - -

District No. 14  
Geographic Region  
Forester Smith

DBH		SAPLING COUNT					DBH	SAPLING COUNT								
2		6					4	18								
PULPHWOOD—HEIGHT TO 4-INCH TOP (FEET)																
10		20		30		40		50		60		70		80		90
6	4	11	12													
8	6	17	27							8						
12			2	1												
16				2												
SAWTIMBER—SAW-LOG MERCHANTABLE HEIGHT (LOGS)																
10	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0							
12	5	20	20	1												
14	2	16	25	8												
16	16	12														
18	2	15	14													
20	1	2	3	1												
	1	4	4	1												

Exhibit 2. - - TOTAL TREE MULTI-PRODUCT CRUISE PROGRAM--Summary Form for Recording Cruise Counts

District No. 14 Case No. 16A Landowner John Doe Address Main St. Athens, Ga 30605  
 Geographic Region 4 Acreage in Tract 40 No. Areas in Tract \_\_\_\_\_ Tract Location Green Co  
 Forester Smith Address Athens, Ga. Phone 404-546-2441  
 Area No. 1 Area Acreage 40 Type Cruise Point No. Plots 40 Planted or Natural Natural  
 Area Identification Pine-Hardwood Species Hard + Soft Hardwood Date 4/5/84

PLOT NO.	Hard Hardwood										Soft Hardwood									
	DBH	COUNT	DBH	COUNT	DBH	COUNT	DBH	COUNT	DBH	COUNT	DBH	COUNT	DBH	COUNT	DBH	COUNT	DBH	COUNT	DBH	COUNT
1																				
2																				
3																				
4																				
5																				
6																				
7																				
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9																				
10																				
11																				
12																				
13																				
14																				
15																				
16																				
17																				
18																				
19																				
20																				

SANTIMBER--SAW-LOG MERCHANTABLE HEIGHT (LOGS)

	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5
12																
14																
16																
18																
20																
22																

## Microcomputer Example

The microcomputer version is distributed on two 5-1/4-inch double-sided, double-density floppy disks. The program disk contains NCI's p-System operating system and the compiled PASCAL code for the TTMP Cruise Program. The second disk is the work disk and contains the species weight and volume equation coefficients and is used to store cruise data output for printing.

To run the micro version, place program disk in drive A and the work disk in drive B and "boot-up" the computer. After the NCI copyright message, the introduction describing TTMPCP will appear on the screen as shown below:

```

    $$$$ $$$$ $ $ $$$$ $$$$ $$$$
    $    $    $$ $ $ $ $ $ $ $ $
    $    $    $ $ $ $$$$ $    $$$$
    $    $    $ $ $ $    $    $ $
    $    $    $ $ $ $    $$$$ $
```

The Total Tree Multi-Product Cruise Program is designed to estimate total tree, saw log, pulpwood, and firewood weight and volume of forest stands from standing tree cruise data. TTMPCP was developed by the USDA Forest Service Southeastern Forest Experiment Station in cooperation with the Georgia Forestry Commission and the University of Georgia School of Forest Resources.

Version 1A - 12/84

Press space bar to continue.

The program options menu will appear after pressing the space bar. This screen lists the options available to the user.

\$\$\$\$\$	\$\$\$\$\$	\$ \$	\$\$\$\$\$	\$\$\$\$\$	\$\$\$\$\$
\$	\$	\$ \$ \$	\$ \$	\$ \$	\$ \$
\$	\$	\$ \$ \$	\$\$\$\$\$	\$	\$\$\$\$\$
\$	\$	\$ \$	\$	\$ \$	\$
\$	\$	\$ \$	\$	\$\$\$\$\$	\$
<p style="text-align: center;">Program Options Menu</p> <p>B(ack-up Program and/or Work disk (Format and Copy)</p> <p>R(eplace Work disk</p> <p>E(nter cruise data for a tract</p> <p>P(rint output tables for a tract</p> <p>D(elete a tract from the cruise data file</p> <p>C(ompress cruise data file</p> <p>T(erminate program</p> <p>Give desired option:</p>					

B(ack-up Program and/or Work Disks. The program has a built-in back-up (B) option that allows the user to format disks and make back-up copies of both the program disk and work disk. When the user purchases the TTMP Cruise Program, the royalty is paid to Softech Microsystems Inc. and NCI copyrights of the UCSD p-System. The user has the right to make two back-up copies of the program disk for use on the computer but does not have the right to reproduce the program for distribution. The user should make a back-up copy of the program and work disks and store the originals in a safe place before using the program.

To make back-up copies hit "B," and the following instructions will appear on the screen. Data entered by the user is shown in a box  .



\* \* \* F O R M A T   A N D   C O P Y \* \* \*

Which disk do you wish to produce a back-up for?

( "A"=Program disk, "B"=Work disk, E(scape) ==>  )

Remove Work disk in Drive B and replace it with the disk to be formatted and copied onto.

Note: This new disk must be double sided/double density.

Press space bar to continue.

When format and copy are complete, the screen will display the following instructions.

\* \* \* F O R M A T   A N D   C O P Y \* \* \*

Formatting and copying for new Program disk completed.  
Remove this disk from Drive B, label it, and replace it with the Work disk you removed earlier.

Note: You must have a Program disk in Drive A  
and a Work disk in Drive B to continue  
running TTMPCP.

Press space bar to continue.

To make a back-up of the work disk enter "B" and follow the instructions which appear on the screen. After making a copy of the work disk, replace it with a program disk in the A drive and then hit the space bar to continue. The program options menu will again appear on the screen.

R(eplace Work Disk. When the user wants to replace the work disk in the B drive with another work disk without rebooting, the "R" option for replacing work disks must be used. When "R" is pressed the following instructions will appear on the screen.

You may change the Work disk in Drive B at this time.

The disk you replace it with must also be a Work disk and may be newly created or one that has been used previously.

Press space bar to continue.

E(nder Cruise Data. To enter cruise data for a tract, press the "E" and the following table headings input screen will appear:

Listed below are headings that will appear on your output tables.  
Please enter information as indicated by cursor.

LANDOWNER : <u>JOHN DOE</u>	CASE NO : <u>16A</u>
ADDRESS : <u>ATHENS, GA</u>	DISTRICT NO : <u>14</u>
TRACT LOCATION : <u>GLYNN CO</u>	TRACT SIZE (AC): <u>40</u>
FORESTER : <u>SMITH</u>	PHONE : <u>912-546-2441</u>
ADDRESS : <u>WAYCROSS, GA</u>	NO. AREAS CRUISED IN TRACT: <u>1</u>
PHYSIOGRAPHIC REGION (T): COASTAL	DATE (T): 84 / 12 / 09
Are you satisfied with the entries as shown? (Y or N) : <u>Y</u>	

The user enters the heading information in the box describing the cruise and presses the enter key and the cursor moves to the next entry. The headings with a (T) are toggle entries. The user presses the space bar to toggle in the desired answer and then presses the enter key or carriage return to enter the selection into memory. For example, the toggle selections for physiographic region are Coastal, Piedmont, or Mountain. The year, month, and day are each toggle entries. The last question in this screen asks if the user is satisfied with the entries. If the user enters "N" for "no," the following edit instructions will appear at the top of the screen:

To correct entry indicated by cursor, press SPACE BAR and re-enter, or retoggle. If entry is correct, a CARRIAGE RETURN moves cursor to the next entry.

When the user is satisfied with the tract heading entries and presses a "Y" for "yes," the screen for entering area information shown below will appear:

Enter the necessary information for Area 1, as indicated by the cursor. For toggle questions (T) hit toggle (SPACE BAR) until appropriate answer appears. Press carriage return (CR) to accept entry.

ACREAGE :

STAND ID./LOCATION :

TYPE OF CRUISE (T) : PRISM

PRISM FACTOR (T): 10 BAF

NUMBER OF PLOTS :

GROWTH PROJECTION (T): YES

YEARS PROJECED (T): 5

INCREMENT CORE DATA ? (T): NO

Are you satisfied with the entries as shown? (Y or N) :

The user enters the acreage for the area and an alpha-numeric identification or name for the area cruised. The type of cruise, blow-up factor, and number of plots entered in this screen are for all trees tallied or trees  $> 5.0$  inches d.b.h. if saplings were cruised differently. Cruise information for saplings tallied by a different cruise procedure will be entered later in the program. The toggle is used to select from fixed-area, prism, strip, or 100 percent tally for type of cruise. When selecting fixed-area cruise, the toggle is used to select the plot size-- $1/4$ ,  $1/5$ ,  $1/10$ ,  $1/20$ ,  $1/50$ ,  $1/100$  acre, or other--and the user enters a radius in feet. For prism cruise, the toggle is used to select a prism basal-area factor (BAF) of 10, 5, or other, and the user enters a BAF factor. When entering fixed-area or prism cruises the user must enter the number of plots or points tallied in the area or the program will default to one plot or point. When strip cruise is selected, the user can enter the width and

cumulative length of the strip in feet or enter the percentage of the area in the strip. For growth projection, the toggle allows the user to enter "yes" or "no." If growth projection is requested, the toggle is used to select the number of years growth to be projected (1 to 5) and whether increment core measurements are to be entered for making growth projections. To obtain growth projections for one or more areas in a tract, growth projection must be requested for the first area entered.

At the bottom of this screen, the program asks if the user is satisfied with the entries. If the user enters "N," the following edit instructions will appear at the top of the screen:

To correct entry indicated by cursor, press SPACE BAR and re-enter, or retoggle. If entry is correct, a CARRIAGE RETURN moves cursor to the next entry.

When the user is satisfied with the area information entries and presses "Y," the screen that allows the user to select the tree dimensions recorded during a cruise will appear as shown below:

TREE DIMENSIONS RECORDED DURING CRUISE AS CURRENTLY SET IN PROGRAM

SPECIES	TREE SIZE CLASS	DIMENSIONS MEASURED	STEM PULPWOOD TOP DOB (IN.)	DBH INTERVAL (IN.)	HEIGHT INTERVAL (FT./LOGS)
PINE	SAPLINGS	DBH		2	
PINE	PULPWOOD	D+H4	4	2	10
PINE	SAWTIMBER	D+MH	4	2	LOGS
H-HWD	SAPLINGS	DBH		2	
H-HWD	PULPWOOD	D+H4	4	2	5
H-HWD	SAWTIMBER	D+MH	4	2	LOGS
S-HWD	SAPLINGS	DBH		2	
S-HWD	PULPWOOD	D+H4	4	2	5
S-HWD	SAWTIMBER	D+MH	4	2	LOGS

Are you satisfied with the entries as shown? (Y or N) : ☒ Y

If the user is not satisfied with the preselected dimensions recorded as shown and presses "N," the following edit instructions will appear at the top of the screen:

Indicate (Y or N) if satisfied with line shown.  
 To correct entry indicated by cursor, press SPACE BAR to toggle responses.  
 If entry is correct, a CARRIAGE RETURN moves cursor to the next entry.

The screen showing tree dimensions recorded is edited a line at a time. If satisfied with the line indicated by the cursor press "Y," if not, press "N" and the cursor will move to the next entry in the line. All entries are a toggle. The d.b.h. or d.b.h. and height combinations under dimensions measured from which the user can select are listed on page 3 for each tree size class. For stem pulpwood d.o.b. top, the user can toggle-in 1 to 6 inches for pine or hardwood pulpwood and pine sawtimber and 1 to 8 inches for hardwood sawtimber. D.b.h. interval can be 1 or 2 inches and height interval can be 5 or 10 feet, or 1/2 logs. The tree dimension selected must be the same for hard hardwoods and soft hardwoods except for the stem pulpwood top d.o.b.

When the user is statisfied with the entries for dimensions measured and presses "Y," the following screen showing default values for pounds per cord equivalents and sawtimber form class will appear:

DEFAULT VALUES FOR PINE, HARD HARDWOOD, AND SOFT HARDWOOD		
	POUNDS PER CORD EQUIVALENT	SAWTIMBER FORM CLASS
=====		
PINE =>	5600.00	78
H-HWD =>	5700.00	78
S-HWD =>	5700.00	78
=====		
Are you satisfied with the entries as shown? (Y or N) : <input checked="" type="checkbox"/> Y <input type="checkbox"/> N		

If the user wants to change one or more of these preselected values and presses "N," the following edit instructions will appear at the top of the screen:

To correct entry indicated by cursor, press SPACE BAR and re-enter, or retoggle. If entry is correct, a CARRIAGE RETURN moves cursor to the next entry.

The space bar is used to delete the current value indicated by the cursor and the user can enter values ranging from 4,000 to 8,000 for pounds per cord and form class values ranging from 65 to 90.

When the user is satisfied with the entries and presses "Y," the screen that allows the user to select output tables will appear as shown below:

# OUTPUT TABLE OPTIONS

```
=====
                        ESTIMATE
                PER ACRE                PER AREA
=====
TABLE 1-- BD FT BY DBH CLASS
  DOYLE
  SCRIBNER                Y
  INT. 1/4
TABLE 2-- TREE COMPONENT BY DBH CLASS
  TONS                Y
  CORDS                Y
  CUNITS
TABLE 3-- SUMMARY TABLE
  CURRENT                Y
  PROJECTED                Y
=====
Are you satisfied with the entries as shown? (Y or N) : ☒ Y
```

If the User is not satisfied with the preselected output tables as shown and presses "N," the following edit instructions will appear at the top of the screen:

To correct entry indicated by cursor, press SPACE BAR and re-enter, or retoggle. If entry is correct, a CARRIAGE RETURN moves cursor to the next entry.

Examples of Tables 1, 2, and 3 are shown on pages 43, 44, and 46, respectively. The user can have a table printed on a per acre or per area basis, or both. This screen also allows the user to select the board-foot rules to be used to estimate board-foot volumes shown in Table 1, the units of measure to be displayed in Table 2, and if Table 3 is to be printed showing current and projected estimates. The space bar is used to toggle a "Y" if the user wants the table printed, or a blank if the user does not want it printed.

When the user is satisfied with the entries and presses "Y," the screen allowing the user to select the species tallied in the cruise will appear as shown below:

Listed below are the tree species for which tree component weight and volume equations are available for the Coastal region. Indicate those tallied in Area 1 with a Y(es. Press N(o or <SP> to continue through list.

PINE----->	X	PLANTATION PINE----->
HARD HARDWOODS----	X	CYPRESS----->
SOFT HARDWOODS----	X	
OAK SP.----->		
LIVE OAK----->		
SWEETGUM----->		
PINE2----->		
SAND PINE----->		

Are you satisfied with the selections made above? (Y or N) : ☒ Y

The species or species groups available for each physiographic region are shown on pages 5, to 7. The user can select up to six species or species groups per area and a total of nine per tract. The user presses "Y" if a species is tallied and "N," if not. If the user is not satisfied with the entries and presses "N," the species selections are deleted and the selection process starts over.

When the user is satisfied with his species selections and presses "Y," the additional options screen will appear as shown below:

<p style="text-align: center;">ADDITIONAL PROGRAM OPTIONS</p> <p style="text-align: center;">Respond Y(es or N(o</p> <p>=&gt; Were saplings cruised using a method different from that used in cruising pulpwood/sawtimber? <input type="checkbox"/> N <input type="checkbox"/></p>
---

If the user cruised saplings differently than trees  $\geq 5.0$  inches d.b.h. the program will ask for the type of cruise used and for information related to the cruise, such as prism factor or plot radius and number of points or plots on which saplings were tallied. The cruise information originally entered for the area is assumed to apply to the trees  $\geq 5$  inches d.b.h.

After completing the above question the following option question will appear:

<p>=&gt; Do you desire the sawlog stem, for natural pine, to be separated into plylogs and small sawlogs? <input type="checkbox"/> Y <input type="checkbox"/></p>
---

When the user answers "yes," the following questions will appear on the screen:

For the calculation of plylog weights and volumes, enter the following tree dimension information:		
	DEFAULT VALUE	LOWEST ACCEPTABLE VALUE
Minimum d.b.h. class (in.): <input type="checkbox"/> 14 <input type="checkbox"/>	13.0	11.0
Minimum d.o.b. (in.): <input type="checkbox"/> 10 <input type="checkbox"/>	10.0	8.0
Enter a <CR> if you wish to use the default value.		

The user can then enter the minimum d.b.h. tree from which plylogs can be cut and minimum d.o.b. top to which they can be harvested, or enter a <CR> to use the default values.



After answering the above question, a third question will appear if two or more areas have been cruised within a tract:

=> Do you wish to have Table 3 printed on a tract level (i.e. over all areas cruised)?

When the user answers "Y," Table 3A will be printed summarizing all areas in the tract. Table 3B will also be printed summarizing board-foot volumes across all areas.

When the user tallies plantation pine, the following question will appear:

=> Do you wish chipping-sawlog output for plantation pine species?

☒ Y

If the user enters "Y," the following questions will appear:

For the calculation of chipping-sawlog weight and volumes, enter the following tree dimension information:

	DEFAULT VALUE	LOWEST ACCEPTABLE VALUE
Minimum d.b.h. class (in.): <input type="text" value="7"/>	8.0	6.0
Minimum d.o.b. (in.): <input type="text" value="6"/>	6.0	5.0

Enter a <CR> if you wish to use the default value.

The user can then enter the minimum d.b.h. tree from which chipping sawlogs can be cut and the minimum d.o.b. top to which they can be harvested, or enter a <CR> to use the default values.

After answering the option questions, the user is asked to enter area cruise data by species and tree size class. The program asks that sapling tallies be entered first as shown for the example cruise on pages 11 and 12.

INPUT: N(o data, <SP> accepts entry, <CR> returns for new dbh, E(nd of input

PINE - SAPLINGS (<= 4.0 IN.)

	<u>DBH</u>	<u>TREE COUNT</u>
?	2	6
?	4	18
?	E	

After entering the sapling counts and pressing "E," the screen for inputting pine pulpwood tree counts will appear as shown below:

6	4	11	12	
8		6	17	27
12				2
16				1
E				2

10	5	20	20	1	
12	2	16	25	8	
14		16	12		
16		2	15	14	
18		1	2	3	1
20		1	4	4	1
E					

After entering the appropriate pine sawtimber counts by d.b.h. and height classes and pressing "E," the program will display the d.b.h. and counts as entered for each tree size class and ask if the user is satisfied with the entries. If the user enters "N," the following edit instructions will appear at the top of the screen.

EDIT: N(o changes, <SP> to change line, D(elete line, A(dd to current input

The tree count input screens are edited a line at a time. If the user does not want to make a change for a d.b.h. class, "N" is pressed and the cursor will move to the next d.b.h. class. If the user wants to change the counts entered for a d.b.h. class, the space bar is pressed to delete the counts entered. The user then reenters the counts for the d.b.h. class and presses the carriage return. If the user wants to delete both the d.b.h. and the counts, "D" is pressed and then the d.b.h. and appropriate counts are reentered. If the user wants to add additional d.b.h. classes and counts, "A" is pressed.

After editing the tree tally for a size class, the program will display the tree counts again and ask if the user is satisfied. If the user is satisfied the program will calculate the estimated weights and volumes for the species counts entered and store them on the work disk. The program will then ask the user to input the counts for the next species tallied. For the example in this manual, the program would ask for the hard hardwood tally input and then the soft hardwood input.

If the user indicated that pine increment-core measurements were to be entered, the following instructions would appear on the screen after the counts for pine are entered:

#### PINE INCREMENT CORE MEASUREMENTS

Enter dbh of bored trees to nearest tenth of an inch followed by the radial growth of the last 5 years to the nearest hundredth of an inch. Separate measurements with a blank. Signal end of input with an E(nd <CR>. If no data was collected for a tree class, enter N(one <CR>. Enter data:

FOR AVERAGE PULPWOOD TREES (5.0 TO 8.9 INCHES):

? 6.2 .32

? 7.5 .42

? 8.9 .42

? 6.8 .42

? 8.1 .37

? E

# SUMMARY OF PINE TREE COUNT INPUT DATA

DBH		TREE COUNT		PINE - SAPLINGS											
2		6													
4		18													
PINE - PULPWOOD															
HT. TO 4 IN. TOP(FT.)															
DBH	10	20	30	40	50	60	70	80	90	100	110	120	130	140	
6	4	11	12												
8		6	17	27	8										
PINE - PULPWOOD															
HT. TO 4 IN. TOP(FT.)															
DBH	10	20	30	40	50	60	70	80	90	100	110	120	130	140	
12				2	1										
16					2										
PINE - SAWTIMBER															
MERCHANTABLE HT.(LOGS)															
DBH	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0			
10		5	20	20	1										
12		2	16	25	8										
14			16	12											
16			2	15	14										
18			1	2	3	1									
20			1	4	4	1									

\* THE ABOVE TABLE SUMMARIZES THE GIVEN PINE INPUT. IF YOU ARE SATISFIED, ENTER 'YES'. IF YOU WANT TO MAKE CORRECTIONS IN THE ABOVE TABLE, ENTER THE SIZE CLASSES YOU WISH TO CHANGE OR MAKE ADDITIONS TO (1=SAPLINGS, 2=PULPWOOD, 3=SAWTIMBER, 4=LARGE PULPWOOD). SEPARATE CODES WITH COMMAS.

? ☒ YES CR  
YES

## HARD-HWD CRUISE DATA INPUT SECTION

ENTER HARD-HWD CRUISE DATA.

YOU WILL BE PROMPTED BY SIZE CLASS - IF THERE ARE NO DATA FOR A SIZE CLASS, ENTER 'NONE'. SIGNAL END OF DATA INPUT, FOR EACH SIZE CLASS, WITH AN 'END'.

At this point in the program the user would enter the tree counts by d.b.h. and height classes by tree size class in the same manner as was done for the pine. The program would then print out the summary of the hard hardwood input for the user to check and make corrections. After telling the program the hard hardwood input data were correct, the program would ask for soft hardwood data input.

After the cruise data for each species tallied in an area have been entered, the program will ask the following question if more than one area in a tract has been cruised.

DO YOU WANT TO CONTINUE THE NEXT AREA (Y OR N)  
?

Data entry for each area in a tract starts with question 3 (page 30). After answering question 3 for an area the following question will be asked:

THE STORED PRESELECTED CRUISE PARAMETERS USED FOR THE PREVIOUS AREA WILL BE USED FOR THIS AREA UNLESS SPECIFIED OTHERWISE. ENTER 'YES' TO REUSE THESE STORED OPTIONS OR 'NO' IF CHANGES ARE DESIRED.

If the above question is answered "Yes," the program will immediately ask for cruise data entry. If the above question is answered "No," the program will ask question 4 (page 32).

After all cruise data for each area have been entered, the computer will calculate estimated weights and volumes and route output to the terminal or line printer.

## Output and Examples

Output from this program is designed to provide the forester, landowner, or timber buyer with information to evaluate the utilization options for marketing the timber. The output from the program shows the aggregate weight and volume of the total tree above-stump for trees in the stand by species or species groups. It breaks down these estimates into saw logs, plylogs, pulpwood, crown firewood, and logging residue and gives these estimates in tons, cords, cunits and board feet per acre or by area and tract totals. This information is provided in four basic output tables: a table showing board-foot volume by d.b.h., a table showing total-tree and tree-component biomass by d.b.h. class, a summary table, and a table showing projected annual growth by stand component and species.

Exhibit 3 is an example of the output displayed in Tables 1A, 1B, and 1C which show predicted gross board-foot volumes based on the Doyle, Scribner, or International 1/4-inch board-foot rules, respectively. These output tables show the predicted board-foot volume by d.b.h. class, the totals for each species, and the total board feet over all species for the specified form class; also displayed are the average saw-log heights and numbers of trees by species and d.b.h. class.

Exhibit 4 is an example of the output displayed in Tables 2A, 2B, and 2C which show estimated total-tree and tree-component biomass expressed in tons, cords, and cunits, respectively. These output tables show predicted biomass for the total tree above-stump, stem from butt to the specified pulpwood top, saw-log stem, stem pulpwood, and hardwood crown firewood  $\geq 4$  inches d.o.b. Stem pulpwood consists of the stem from butt to the specified pulp d.o.b. top in pulpwood trees and the stem pulpwood above the sawtimber top in sawtimber trees. When planted pine cruise data are analyzed and chipping saw logs are requested, Table 2 will display the weight or volume of chipping logs instead of saw logs. Also shown in Table 2 is the average height and the estimated number of trees by d.b.h. classes.

EXHIBIT 3.--EXAMPLE OF TABLE 1B SHOWING ESTIMATED SCRIBNER BOARD-FOOT VOLUME FOR FORM CLASS 78 BY DBH CLASS.

TOTAL TREE MULTI-PRODUCT CRUISE PROGRAM

LANDOWNER - JOHN DOE  
 ADDRESS - MAIN ST ATHENS GA 30602  
 TRACT LOC. - GLYNN CO  
 AREA 1 - PINE-HARDWOOD  
 FORESTER - SMITH  
 ADDRESS - WAYCROSS GA

CASE NO. - 16A  
 DISTRICT NO. - 14  
 TOTAL TRACT(AC) - 40.0  
 AREA 1 ACREAGE - 40.00  
 PHONE - 912-546-2441  
 DATE - 84/12/09

TABLE 1B--PREDICTED SCRIBNER GROSS SAWLOG BD.FT. VOLUME BY DBH CLASSES.  
 CURRENT ESTIMATES - YIELD PER ACRE

DBH (IN.)	AVERAGE HEIGHT ------(LOGS)-----			EST. NO. OF TREES ------(NUMBER)-----			SAWLOG VOLUME-SCRIBNER,FC /1/ ------(THOUSAND BOARD FEET)-----			
	PINE	HHWD	SHWD	PINE	HHWD	SHWD	PINE	HHWD	SHWD	ALL SPECIES
10	1.7	.0	.0	21.1	.0	.0	.8	.0	.0	.8
12	1.9	1.5	2.0	16.2	1.6	2.5	1.2	.1	.2	1.4
14	1.7	1.8	2.4	6.5	3.7	5.1	.7	.4	.7	1.7
16	2.2	2.0	2.5	5.6	.7	.7	.9	.1	.1	1.2
18	2.3	2.0	.0	1.0	.3	.0	.2	.1	.0	.3
20	2.3	.0	.0	1.1	.0	.0	.3	.0	.0	.3
ALL CLASSES				51.6	6.3	8.4	4.1	.7	1.0	5.8

/1/ FORM CLASS: PINE= 78.; SOFT HWD= 78.; HARD HWD= 78.

EXHIBIT 4.--EXAMPLE OF TABLE 2A SHOWING ESTIMATED TOTAL-TREE AND TREE-COMPONENT BIOMASS IN TONS BY DBH CLASS.

TOTAL TREE MULTI-PRODUCT CRUISE PROGRAM

LANDOWNER - JOHN DOE	CASE NO. - 16A
ADDRESS - MAIN ST ATHENS GA 30602	DISTRICT NO. - 14
TRACT LOC. - GLYNN CO	TOTAL TRACT(AC) - 40.0
AREA 1 - PINE-HARDWOOD	AREA 1 ACREAGE - 40.00
FORESTER - SMITH	PHONE - 912-546-2441
ADDRESS - WAYCROSS GA	DATE - 84/12/09

TABLE 2A--PREDICTED TOTAL TREE AND COMPONENT BIOMASS BY DBH CLASSES.  
CURRENT ESTIMATE - YIELD PER ACRE

DBH	AVERAGE HEIGHT	EST. TREES	TOTAL TREE	STEM TO PULP TOP /1/	SAWLOGS	STEM PULPWOOD	FIREWOOD >= 4 IN.
IN)	(FT.&LOGS)	(NO.)	-----TONS-----				
PINE							
--SAPLINGS--							
2	.0	68.8	.6				
4	.0	51.6	2.9				
--PULPWOOD--							
6	23.0	34.4	5.1	3.3		3.3	
8	36.4	41.5	13.0	10.6		10.6	
12	43.3	1.0	.7	.6		.6	
16	50.0	.4	.5	.4		.4	
--SAWTIMBER--							
10	1.7	21.1	9.9	8.8	7.1	1.7	
12	1.9	16.2	12.7	10.4	8.4	1.9	
14	1.7	6.5	6.9	5.3	4.1	1.2	
16	2.2	5.6	8.5	6.7	5.6	1.1	
18	2.3	1.0	1.9	1.5	1.3	.2	
20	2.3	1.1	2.7	2.1	1.8	.4	
LL LASSES		249.1	65.4	49.9	28.3	21.6	

1/ STEM PULPWOOD TOP:

PULPWOOD - 4-IN. FOR PINE; 4-IN. FOR HHWD; 4-IN. FOR SHWD.  
SAWTIMBER - 4-IN. FOR PINE; 4-IN. FOR HHWD; 4-IN. FOR SHWD.

The summary consists of two tables, Table 3A and Table 3B. Table 3A (Exhibit 5) shows the predicted total biomass of all trees in the stand in tons, cords, and cunits for each species and all species combined. Estimated total biomass is displayed for saplings (1.0 to 4.0 inches), and for trees  $\geq 5.0$  inches d.b.h. The biomass in trees  $\geq 5.0$  inches is divided into material in the stem to the specified pulpwood top and material in the crown (branches and stem above the pulp d.o.b. top). The stem to a pulpwood top is further separated into saw-log and pulpwood components. The pulpwood component consists of estimates of pulpwood from pulpwood-size trees and of that which comes from the tops of sawtimber-size trees. When natural pine data are analyzed and the user selects the plylog option, the saw-log stem is separated into plylogs and small saw logs and their weights and volumes displayed. The amount of crown that is  $\geq 4$  inches d.o.b. is also displayed for hardwoods as crown firewood. When planted pine cruise data are analyzed and the chipping-log option selected, chipping-log estimates are displayed instead of saw-log estimates in Table 3A.

Table 3B (Exhibit 6) displays the total board-foot volume for each species by the desired log rules for all saw logs, small saw logs, and plylogs. This table also shows the estimated average basal areas per acre in square feet and average quadratic mean d.b.h. for saplings, pulpwood, and sawtimber-size trees for each species.

Output Table 4 (Exhibit 7) shows the projected annual growth by stand component for each species tallied. Annual growth estimates are based on 5-year increment-core measurements of radial growth entered by the user, or stored average annual radial growth values. The present volume per acre, present growth per acre per year, and total annual growth for the stand-by-stand component are displayed. Annual growth is expressed in board feet for saw logs, in cords for pulpwood, and in tons for total-tree chips. When planted pine chipping-log estimates are desired, chipping-log annual growth is expressed in cords. The stem to pulp top growth values in Exhibit 5 are for the total stem from butt to the pulp top and the pulpwood values are for pulpwood from pulpwood-size tree and tops of sawtimber-size trees. Percent annual change per acre is also shown for each stand component.

Using the stand table projection method, the current tree tallies can be projected for up to 5 years and Tables 3A and 3B can be reprinted to show estimates of future weights and volumes. Output Tables 1 to 3 can be printed on a per-acre or area basis. Tables 3A and 3B, the summary tables showing current or projected weight and volume, can be printed to summarize all areas within a tract. Table 4, the table showing annual growth, can also be printed to summarize growth by stand component for a tract.

## Interpretation of Output

The TTMP Cruise Program is designed to predict gross total-tree and tree-component stand weights and volumes by using regional species equations. Thus, these estimates should be interpreted and used carefully. Estimates are made assuming efficient utilization will be followed during timber harvesting. If the loggers fail to cut saw logs to the upper stem limit cruised, or cut stem pulpwood to only a 6-inch rather than a 4-inch small end diameter, the program will overestimate product yields. Therefore, users should change pulpwood top diameters used in the program to coincide with local harvesting practices.

The output tables showing biomass by d.b.h. classes (Tables 2A, 2B, 2C) and the summary (Table 3A), contain weight and volume estimates for the basic components of the tree. These basic values permit users to combine component estimates to simulate harvesting practices in their area. For example, in some areas only hardwood saw logs can be sold commercially and no market for hardwood pulpwood exists. Stem pulpwood estimates therefore would be combined with crown firewood and marketed as firewood.



EXHIBIT 5.--EXAMPLE OF TABLE 3A WHICH SUMMARIZES THE PREDICTED TOTAL-TREE AND TREE-COMPONENT WEIGHTS AND VOLUMES BY SPECIES.

TOTAL TREE MULTI-PRODUCT CRUISE PROGRAM

LANDOWNER - JOHN DOE	CASE NO. - 16A
ADDRESS - MAIN ST ATHENS GA 30602	DISTRICT NO. - 14
TRACT LOC. - GLYNN CO	TOTAL TRACT(AC) - 40.0
AREA 1 - PINE-HARDWOOD	AREA 1 ACREAGE - 40.00
FORESTER - SMITH	PHONE - 912-546-2441
ADDRESS - WAYCROSS GA	DATE - 84/12/09

TABLE 3A--SUMMARY OF PREDICTED TOTAL TREE AND COMPONENT WEIGHT AND VOLUME.  
CURRENT ESTIMATE - YIELD PER ACRE

COMPONENT	PINE	HARD-HWD	SOFT-HWD	ALL TREES
GREEN TONS OF WOOD AND BARK				
TOTAL TREE(ALL)	65.4	19.5	18.4	103.3
SAPLINGS(< 5 IN.)	3.5	3.5	3.1	10.1
TOTAL TREE(> 5 IN.)	61.9	16.0	15.2	93.2
STEM TO PULPWOOD TOP /1/	49.9	11.5	12.2	73.6
ALL SAWLOGS /2/	28.3	5.0	7.0	40.3
SMALL SAWLOGS /5/	19.8	.0	.0	19.8
PLYLOGS /6/	8.5	.0	.0	8.5
PULPWOOD (ALL)	21.6	6.5	5.1	33.2
PULPWOOD TREES	15.0	4.5	3.2	22.7
SAWTIMBER TOPS	6.6	2.0	2.0	10.5
TOTAL CROWN	12.1	4.5	3.1	19.6
CROWN FIREWOOD>= 4IN	.0	.9	.7	1.6
CORDS OF WOOD AND BARK /4/				
TOTAL TREE(ALL)	23.4	6.9	6.4	36.7
SAPLINGS(< 5 IN.)	1.2	1.2	1.1	3.6
TOTAL TREE(> 5 IN.)	22.1	5.6	5.4	33.1
STEM TO PULPWOOD TOP /1/	17.8	4.1	4.3	26.1
ALL SAWLOGS /2/	10.1	1.8	2.5	14.3
SMALL SAWLOGS /5/	7.1	.0	.0	7.1
PLYLOGS /6/	3.0	.0	.0	3.0
PULPWOOD (ALL)	7.7	2.3	1.8	11.8
PULPWOOD TREES	5.4	1.6	1.1	8.1
SAWTIMBER TOPS	2.3	.7	.7	3.7
TOTAL CROWN	4.3	1.6	1.1	7.0
CROWN FIREWOOD>= 4IN	.0	.3	.2	.6
VOLUME OF WOOD (CUNITS)				
TOTAL TREE(ALL)	17.6	5.0	5.3	27.8
SAPLINGS(< 5 IN.)	.9	.9	.9	2.7
TOTAL TREE(> 5 IN.)	16.7	4.1	4.3	25.1
STEM TO PULPWOOD TOP /1/	13.5	3.0	3.5	20.0
ALL SAWLOGS /2/	7.8	1.3	2.1	11.2
SMALL SAWLOGS /5/	5.5	.0	.0	5.5
PLYLOGS /6/	2.3	.0	.0	2.3
PULPWOOD (ALL)	5.7	1.7	1.5	8.8
PULPWOOD TREES	4.1	1.2	1.0	6.2
SAWTIMBER TOPS	1.6	.5	.5	2.6
TOTAL CROWN	3.2	1.1	.8	5.1
CROWN FIREWOOD>= 4IN	.0	.2	.2	.4

/1/ STEM PULPWOOD TOP:

PULPWOOD - 4-IN. FOR PINE; 4-IN. FOR HW; 4-IN. FOR SHW.

SAWTIMBER - 4-IN. FOR PINE; 4-IN. FOR HW; 4-IN. FOR SHW.

/2/ SAWLOG MERCHANTABILITY: 7-IN. FOR PINE W/MIN DBH 9-IN., 9-IN. FOR HARDWOOD OR THRU LOG GRADE NO. 3 MERCHANTABILITY W/MIN DBH 11-IN.

/3/ NUMBER MAY NOT ADD DUE TO ROUNDING ERROR.

/4/ POUNDS PER CORD: PINE=5600. HW=5700. SHW=5700.

/5/ SMALL SAWLOGS - MIN 8 F. W/ MIN 7-IN. DOB SMALL END.

/6/ PLYLOGS - MIN 2 8.7 FT. BLOCK W/ MIN 10.0-IN. DOB SMALL END, MIN DBH - 14.0.

EXHIBIT 6.--EXAMPLE OF TABLE 3B WHICH SUMMARIZES THE PREDICTED SAW-LOG BOARD-FOOT VOLUMES AND BASAL AREA PER ACRE BY SPECIES.

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TOTAL TREE MULTI-PRODUCT CRUISE PROGRAM

LANDOWNER - JOHN DOE  
 ADDRESS - MAIN ST ATHENS GA 30602  
 TRACT LOC. - GLYNN CO  
 AREA 1 - PINE-HARDWOOD  
 FORESTER - SMITH  
 ADDRESS - WAYCROSS GA

CASE NO. - 16A  
 DISTRICT NO. - 14  
 TOTAL TRACT(AC) - 40.0  
 AREA 1 ACREAGE - 40.00  
 PHONE - 912-546-2441  
 DATE - 84/12/09

TABLE 3B--SUMMARY OF PREDICTED TOTAL TREE AND TREE COMPONENT WEIGHT AND VOLUME.  
 CURRENT ESTIMATE - YIELD PER ACRE

COMPONENT	PINE	HARD-HWD	SOFT-HWD	ALL TREES
SAWLOG BOARD-FOOT VOLUME---(MBF)/1/				
ALL SAWLOGS				
DOYLE	2.6	.4	.6	3.7
SCRIBNER	4.1	.7	1.0	5.8
SMALL SAWLOGS				
DOYLE	1.6	.0	.0	1.6
SCRIBNER	2.6	.0	.0	2.6
PLYLOGS				
DOYLE	1.1	.0	.0	1.1
SCRIBNER	1.5	.0	.0	1.5
BASAL AREA PER ACRE (SQ.FT.)				
SAPLING TREES	5	4	5	14
PULPWOOD TREES	22	6	5	33
SAWTIMBER TREES	43	6	8	57
ALL TREES	70	16	18	104
QUADRATIC MEAN D.B.H. (IN.)				
SAPLING TREES	3.0	3.2	2.6	2.9
PULPWOOD TREES	7.3	7.4	7.1	7.3
SAWTIMBER TREES	12.4	14.0	13.6	12.7
ALL TREES	7.3	5.6	4.6	6.2

/1/FORM CLASS: PINE= 78.; SOFT HWD= 78. HARD HWD= 78.

EXHIBIT 7.--EXAMPLE OF TABLE 4 WHICH SHOWS PROJECTED ANNUAL GROWTH OVER 5 YEARS BY STAND COMPONENT.

TOTAL TREE MULTI-PRODUCT CRUISE PROGRAM

LANDOWNER - JOHN DOE	CASE NO. - 16A
ADDRESS - MAIN ST ATHENS GA 30602	DISTRICT NO. - 14
TRACT LOC. - GLUNN CO	TOTAL TRACT(AC) - 40.0
AREA 1 - PINE-HARDWOOD	AREA 1 ACREAGE - 40.00
FORESTER - SMITH	PHONE - 912-546-2441
ADDRESS - WAYCROSS GA	DATE - 84/12/09.

TABLE 4.--BASIC INVENTORY AND PROJECTED ANNUAL GROWTH

STAND COMPONENT	PRESENT VOLUME PER ACRE	PRESENT GROWTH PER ACRE PER YEAR	TOTAL ANNUAL GROWTH PER AREA	PERCENT ANNUAL CHANGE PER ACRE
AREA 1-- 40.00 ACRES-PINE-HARDWOOD				
PINE				
ALL SAWLOGS (MBF SCRIB)	4.1	.233	9.34	5.67
SMALL SAWLOGS (MBF)/1/	2.6	.188	4.70	4.49
PLYLOGS (MBF)/2/	1.5	.116	4.64	7.73
STEM TO PULP TOP (CORDS)	17.8	.630	25.18	3.54
PULPWOOD (CORDS)	7.7	.124	4.95	1.61
TOTAL TREE CHIPS (TONS)	65.4	2.074	82.98	3.17
HARD-HWD				
ALL SAWLOGS (MBF DOYLE)	0.4	.018	0.71	3.98
STEM TO PULP TOP (CORDS)	4.1	.152	6.07	3.75
PULPWOOD (CORDS)	2.3	.111	4.42	4.83
TOTAL TREE CHIPS (TONS)	19.5	.545	21.81	2.79
SOFT-HWD				
ALL SAWLOGS (MBF DOYLE)	0.6	.019	0.75	2.99
STEM TO PULP TOP (CORDS)	4.3	.102	4.06	2.38
PULPWOOD (CORDS)	1.8	.056	2.25	3.12
TOTAL TREE CHIPS (TONS)	18.4	.339	13.57	1.85
ALL SPECIES				
ALL SAWLOGS (MBF)				
SAWLOGS (DOYLE)	1.1	.036	1.46	3.40
SAWLOGS (SCRIB)	4.1	.233	9.34	5.67
STEM TO PULP TOP (CORDS)	26.1	.883	35.32	3.38
PULPWOOD (CORDS)	11.8	.290	11.62	2.46
TOTAL TREE CHIPS (TONS)	103.3	2.959	118.35	2.86

/1/SMALL SAWLOGS - MIN 8 FT. W/ MIN 7-IN. DOB SMALL END.  
 /2/PLYLOGS - MIN 2 8.7 FT. BLOCK W/ MIN 10.0-IN. DOB SMALL END,  
 MIN DBH - 14.0.

NOTE: NEGATIVE REFLECTS MOVEMENT OF MATERIAL INTO LARGER SIZE COMPONENT OR MORTALITY GREATER THAN GROWTH.  
 GROWTH ASSUMES APPROX. 1% ANNUAL MORTALITY.

The TTMP Cruise Program assumes that the cruise analyzed was a random sample and will therefore lead to unbiased estimates. These biomass estimates, however, contain errors due not only to harvesting differences but also to biomass prediction equations and timber cruise procedures. When timber is 100 percent cruised, the error associated with the cruise is minimized since all trees are tallied. Preliminary tests of the program that used this cruise procedure indicate that predicted total tree, total stem to pulpwood top, and saw-log weights and volumes will be within + 10 percent of the actual weights and volumes if d.b.h. and some estimate of height are tallied. Biomass of upper stem pulpwood and crown firewood varies considerably more. Users should use these component estimates carefully until they gain field experience as to their reliability. Biomass estimates based on fixed-area plots, point sampling, or strip cruising can contain more error than those based on a 100 percent cruise. To minimize sampling error, plots and strips must be located without bias, border trees must be measured carefully to determine if they are in or out of the cruise, and a sufficient number of plots and strips must be taken.

The growth projections calculated by this program are designed to provide growth information for short-term management planning and when stands are cruised but not harvested for 1 to 5 years. When stand projections are made with the radial growth values stored in the program and which are based on the regional average for the species group, users should apply these values carefully. The stand cruised could be growing at a rate different from the average for their physiographic region. When accurate growth projections are required, the user should enter increment-core growth values for the pulpwood and sawtimber trees cruised. The trees to be bored must be selected randomly to avoid bias in growth estimates.

An average mortality rate (page 10) is assumed in the program when projected growth is calculated. These mortality rates, however, may not be applicable to the stands cruised. Thus, the user should adjust the reported projected growth to account for local mortality rates.

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#### Literature Cited

- Avery, T. Eugene. Forest measurements. New York: McGraw-Hill Book Co.; 1967. 290 p.
- Bennett, Frank A.; Swindel, Bennee F. Taper curves for planted slash pine. Res. Note SE-179. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 1972. 4 p.
- Clark, Alexander, III; Field, Richard C. TBCP--a computer program that estimates total-tree chips, saw logs, pulpwood, and firewood from cruise summary data. Ga. For. Res. Pap. 21. Macon, GA: Georgia Forestry Commission; 1981. 14 p.
- Clark, Alexander, III; Thomas, Charles E. Weight equations for southern tree species--where we are and what is needed. In: Daniels, R. F.; Dunham, P. H., eds. Proceedings, 1983 Southern forest biomass workshop: 1983 June 15-17; Charleston, SC. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 1984: 100-106.
- Mesavage, Clement; Girard, James W. Tables for estimating board-foot volumes of timber. Unnumbered publ. U.S. Department of Agriculture, Forest Service; 1956. 94 p. [Available from: Supt. of Documents, U.S. Government Printing Office, Washington, DC]
- Miant, Harry Y., Jr.; Castaneda, Froylan. 1977. Mesavage and Girards' volume tables formulated. BL4 4. Denver, CO: U.S. Department of Interior, Bureau of Land Management; 1977. 5 p.